MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 1, 2015/2016

DIM5058 – MATHEMATICAL TECHNIQUES 1

(*for diploma students only*)

10 OCTOBER 2015
2.30 p.m. – 4.30 p.m.
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 3 pages excluding cover page and appendix.

2. Attempt ALL **FOUR** questions. All questions carry equal marks and the distribution of the marks for each question is given.

3. Please write all your answers in the Answer Booklet provided.

4. Key formulae are given in the Appendix.

Please answer ALL questions and show the necessary working steps. Each question is 25 marks.

Question 1

a. Simplify and express the answer in terms of positive exponents. (4 marks)

$$\frac{\left(16a^2b^8c^{-4}\right)^{\frac{3}{4}}}{\sqrt{16ab^{-2}}}$$

b. Simplify and factorize, $\frac{x^2-2x-8}{2x^2+10x+12} \div \frac{x^2-6x+8}{x^2+3x}$. (6 marks)

c. Solve the given equation, $2p^2-7p+4=0$ by using the quadratic formula. (4 marks)

d. Solve the linear inequality, express your answer in interval notation, and sketch the solution on a real number line.

i. $3x-\frac{1}{4}<\frac{5}{2}x$ (4 marks)

ii. $2+\left|\frac{3x-8}{7}\right| \geq 3$ (7 marks)

[TOTAL 25 MARKS]

Question 2

a. Given $f(x)=2x-3$ and $g(x)=\frac{2}{4x^2-12x+9}$.

i. Find $(f \cdot g)(x)$ and simplify the expression. (2 marks)

ii. Find $(g \circ f)(x)$ and simplify the expression. (4 marks)

iii. From the answer in **a(ii.)**, find $(g \circ f)(7)$ (2 marks)

b. What are the type of functions listed below? Identify them as either **constant, linear, quadratic** or **rational** function. (2 marks)

i. $f(x)=\frac{(2x+1)}{(5x-10)}$

ii. $f(x)=20^2$

iii. $f(x)=\frac{2}{7}x-\frac{7}{3}$

iv. $f(x)=x^2-4$

Continued.....

c. Given the quadratic function; $f(x) = 4(x+3)^2 - 25$

i. Find the vertex of the parabola. (1 marks)

ii. Find the x-intercept(s) and y-intercept. (6 marks)

iii. Sketch the parabola and label the important points. (3 marks)

d. Find the amplitude, period and phase shift of the function $y = -\frac{1}{2}\sin\left(\frac{2x}{3} + \frac{\pi}{4}\right)$. (3 marks)

e. Convert the radian measure to degree measure for $\frac{7\pi}{4}$. (2 marks)

[TOTAL 25 MARKS]

Question 3

a. Given that $A = \begin{bmatrix} 1 & 2 \\ 3 & -1 \\ 4 & 5 \end{bmatrix}$ *and* $B = \begin{bmatrix} 2 & -1 & 4 \\ 1 & 3 & 1 \end{bmatrix}$

i. Find $\boldsymbol{AB}$. (4 marks)

ii. Find $\boldsymbol{BA}$ and show that $\boldsymbol{AB \neq BA}$. (4 marks)

b. A furniture company produce three types of furniture models for office use; small-model (SM), medium-model (MM) and large-model (ML) respectively. The small-model consists of 1 cabinet, 10 chairs and 5 tables. The medium model furniture consists of 2 cabinets, 18 chairs and 7 tables while the large model consists of 3 cabinets, 24 chairs and 10 tables.

i. If the total profit obtained from cabinets, chairs and tables is RM 840, RM 7420 and RM 3050 respectively, represent this information in the form of $\boldsymbol{AX = B}$. *[Hint: let x, y and z be the small-model, medium-model and large-model respectively.]* (2 marks)

ii. By using the *Cramer's Rule*, find the number of each of the models. (15 marks)

[TOTAL 25 MARKS]

Continued.....

Question 4

a. Find the sum of the sequences

i. $\sum_{i=2}^{5} \frac{(i+2)!}{i!}$ (3 marks)

b. An auditorium in MMU has 20 seats on the first row, 24 seats on the second row, 28 seats on the third row, and so on. If the auditorium has 30 rows of seats, what is the total number of seats in the auditorium? (5 marks)

c. Find the sum to infinity of the following series :

$16, -4, 1, -\frac{1}{4}, \ldots$ (3 marks)

d. In a geometric sequence, the sum of the 3rd and 4th terms is 60 and the sum of the 4th and 5th is 120. Find the **first term** and the **common ratio**. (7 marks)

e. By using the Binomial Theorem, list down the first six terms of the following expansion $(x^2 - \frac{1}{2})^9$ (7 marks)

[TOTAL 25 MARKS]

End of Page.

Appendix:

Completing the square

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$$

Quadratic formula

If $ax^2 + bx + c = 0$ where $a \neq 0$, then

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Standard form of the equation of a circle

$$(x - h)^2 + (y - k)^2 = r^2$$

Standard form of a quadratic function

$$f(x) = a(x - h)^2 + k,\ a \neq 0$$

Trigonometric functions

$y = A \sin(Bx - C)$ or $y = A \cos(Bx - C)$

amplitude $= |A|$, period $= \frac{2\pi}{B}$, and phase shift $= \frac{C}{B}$.

Inverse of a 2 × 2 matrix

If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$, then $A^{-1} = \frac{1}{ad - bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$, where $ad - bc \neq 0$.

Determinant of a 3 × 3 matrix

$$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1\begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1\begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1\begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$$

Cramer's Rule for 3 × 3 matrix

$a_1x + b_1y + c_1z = d_1$
$a_2x + b_2y + c_2z = d_2$
$a_3x + b_3y + c_3z = d_3$

then $x = \frac{D_x}{D}, y = \frac{D_y}{D}, z = \frac{D_z}{D}$ where

$$D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, \; D_x = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}, \; D_y = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}, \; D_z = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$$

Arithmetic sequence

$$a_n = a_1 + (n-1)d$$
$$S_n = \frac{n}{2}(a_1 + a_n)$$

Geometric sequence

$$a_n = a_1 r^{n-1}, \; S_n = \frac{a_1(1-r^n)}{1-r}$$
$$S_\infty = \frac{a_1}{1-r}, |r| < 1$$

Binomial Theorem

$$(a+b)^n = \sum_{k=0}^{n} \binom{n}{k} a^{n-k} b^k; \quad n \geq 1$$

The $(r+1)^{st}$ term in the expansion of $(a+b)^n$ is $\binom{n}{r} a^{n-r} b^r$.